University Affiliated Research Centers

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University Affiliated Research Centers (UARCs) are DOD-approved collaborative partnerships between academia, government and industry. They combine universities' cutting-edge research capabilities, industry's expertise in technology manufacturing and the knowledge of government scientists on how to shape basic research understanding into technology that satisfies warfighting needs. UARCs are affiliated with major universities that conduct research in scientific areas with potentially high-payoff, paradigm-shifting technology applications. The Army seeks to exploit the opportunities created by UARCs to accelerate development of transformational capabilities to a lighter, smarter, faster force.

UARCs are established to promote innovation and facilitate rapid maturation and transition that laboratory knowledge to practical technical applications. The university, government scientist and industrial teaming is key to achieving success in translating knowledge and understanding into a feasible acquisition program.

Nanotechnology for the Soldier

The Institute for Soldier Nanotechnologies (ISN) was formally established as a UARC May 22, 2003. ISN is a collaboration between the Massachusetts Institute of Technology (MIT), U.S. Army, and industry partners Dupont, Raytheon, Dow Corning and the Center for Integration of Medicine and Innovative Technology. Nanotechnology seeks to enable the design and creation of novel materials or devices at the nanometer scale, often at the level of individual atoms and molecules (1 nanometer is about 50,000 times smaller than the diameter of a human hair). Nanostructures would be assembled into macroscopic systems to produce materials with performance characteristics that are not achievable today.

The goal of ISN's specific work is to enable ultra-lightweight materials for soldier protection integrated into warfighting ensembles. ISN's cutting-edge research focuses on soldier survivability in three key areas: ballistic protection from high-speed projectiles, blasts and chemical/biological threats; soldier performance improvements; and medical interventions. Research supports revolutionary capabilities including multithreat protection against ballistic projectiles, sensory attack and chemical and biological agents; soldier ensembles with climate control; remote biomedical monitoring; and physiological stress management. For example, research efforts in mechanically active materials will provide actuators for body armor or exoskeletal support (for load-carrying systems, wound compresses and splints embedded in uniforms) and pressure/motion sensors to remotely monitor soldier health. Signature management technology will provide embedded sensors to detect enemy range-finding or target designation surveillance. Soldier medical technology will provide triage information and embedded first-aid.

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ISN currently has a multidisciplinary staff of 34 faculty, 80 graduate students and 28 postdoctoral research associates from several departments in MIT's schools of engineering and science; it will also include government and industry scientists. MIT has established ISN building space of more than 30,000 square feet with a state-of-the-art nanotechnology laboratory and office space for students, visiting researchers and

MIT faculty. The laboratory is designed to foster collaborative research across many disciplines, including mechanical engineering, chemical engineering, chemistry and materials science. The ISN laboratory is also situated for easy access to the rest of MIT's world-class research infrastructure.

Advanced Simulation and Immersive Environments

The Institute for Creative Technologies (ICT) UARC was established in 1999 with the University of Southern California to exploit research and technology opportunities in advanced gaming and entertainment industry simulations for Army applications. ICT leverages the resources and talents of the entertainment and game development industries to work collaboratively with computer and artificial intelligence (AI) scientists to advance state-of-the-art immersive simulation capabilities. This innovative center's long-term goal is to enable creating virtual reality systems that could take the form of immersive environments like the "Holodeck," used in the *Star Trek* television and movie series. This work will one day make possible a four-dimensional simulated interactive world with holographic images, directional sound and olfactory and tactile experiences.

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ICT research in modeling and simulation focuses on technologies for immersion, networked simulation, computer-generated autonomy and tools for creating simulated natural environments. Applications include visual prototyping of equipment and concepts, mission planning and rehearsal and adaptable leader training. The ICT/Army Experience Learning System provides the ability to learn through active learning systems.

ICT engages entertainment industry researchers to capitalize on innovations in multimedia, location-based simulation and interactive gaming. Exploiting dual-use technology, ICT creates opportunities for the Army to benefit from and transfer applicable entertainment technologies into military training systems. Working with some of the most creative entertainment industry talent, ICT adapts their artistic concepts of story and character to increase the degree of participant immersion in synthetic environments and to improve the realism and usefulness of these experiences for support training and mission rehearsal. The Mission Rehearsal Exercise System, a simulator that uses AI-based virtual humans to challenge trainees with dilemmas they might encounter in peacekeeping operations, received the Defense Modeling and Simulation Office/ National Training Systems Association *Outstanding Achievement Award in Modeling and Simulation Training*.

ICT has already successfully collaborated with several Army organizations to speed products from research into practical applications. It has worked with the U.S. Army Training and Doctrine Command's Infantry School at Fort Benning, GA, to develop cognitive leadership training aids that leverage both "gamer" PC's *(Full Spectrum Commander)* and Microsoft's© X-Box® game console *(Full Spectrum Warrior)*. Both training aids feature Explainable Artificial Intelligence developed at ICT. *Full Spectrum Warrior* is now in final development and could be in soldiers' hands before the end of the year. *Full Spectrum Commander* is already in use training soldiers in Afghanistan. At this year's annual Electronic Entertainment Expo, *Full Spectrum Warrior* won two Game Critics Awards: "Best Original Game" and "Best Simulation Game."

The Critical Leadership Analysis System, developed for the Army Research Institute at Fort Leavenworth, KS, combines coordination architecture, a machine learning approach to natural language processing and a novel algorithm for automated animation of rendered human faces in an application designed for interactive learning of leadership skills.

ICT is currently developing the Joint Fires and Effects Trainer System as a training component for the Fort Sill, OK, Joint Fires and Effects Integration Center. This project includes groundbreaking work in virtual human depiction and graphical capabilities similar to the ICT-developed "FlatWorld" system to create a series of immersive environments for training the "universal observer" of the future.

Biotechnology

The Institute for Collaborative Biotechnologies (ICB), established this year, performs cutting-edge

research in the area of biologically inspired materials and sensors. The actual contract, offered to multiple universities, was awarded in August 2003. This UARC was established to promote rapid progress in biotechnology, which promises radically new technologies that are expected to impact soldier survivability, early warning and weapons systems. Through this center, the Army seeks to foster the interdisciplinary fundamental knowledge and technical capabilities to manipulate biological systems and components and to exploit biologically derived products and processes for soldier and platform applications.

ICB will conduct scientific research in two areas of emphasis: sensors, electronics and information processing; and technical fundamentals to transition cutting-edge biotechnology research into these application areas. A single university will serve as lead UARC host for ICB, with subcontracts to two other universities to complement the expertise of the host institution and that are fully integrated and networked into the host institution program. The lead university will establish procedures to provide dynamic and real-time collaboration between the three universities, as well as participating team members from industry, Army labs and/or other research centers. The Army's vision for ICB is that it will serve as the network "hub" for assessing, coordinating and leveraging extramural cross-disciplinary biotechnology research on the Army's behalf.

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Electrodynamics, Pulsed Power and Hypervelocity Physics

The Institute for Advanced Technology (IAT) at the University of Texas at Austin was initially founded in 1990 as a Federally Funded Research and Development Center and restructured as a UARC in 1993. The center's principal goal is to develop revolutionary capabilities in lethality. To achieve this, the UARC provides the Army with world-class expertise in electrodynamics, pulsed power, hypervelocity physics and long-term, comprehensive research programs at the forefront of advanced electric weapons technology. It also engages in the specialized training and education of Army personnel to ensure the Army's capability to address the critical scientific, engineering and technical issues associated with developing advanced weapons.

Hypervelocity physics investigation at IAT provides fundamental descriptions of impact dynamics between penetrators and targets. Their electrodynamics research is directed at developing a basic understanding of electromagnetic launchers and their associated pulsed power systems. IAT uses high-performance computing coupled with baseline experiments conducted in their facilities. It is the Army's first UARC dedicated to the scientific underpinnings for electromagnetic launch. It is through the balance between the theoretical foundations and experimental art that IAT has maintained its leadership position in these challenging research areas.

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Did you know?

Effective Oct. 14, 2003, Product Manager (PM) Physical Security Equipment was redesignated as PM Force Protection Systems. The name change reflects the Army's increasing emphasis on force protection capabilities and leveraging technology to improve security while reducing manpower requirements. The program will focus on providing affordable, scalable, modular and supportable tactical force protection capabilities to forward-deployed tactical forces while continuing to provide state-of-the-art physical security equipment to Army installations worldwide. Furthermore, the name change better represents the growing focus on force protection efforts, homeland defense and support to forward support forces.

The PM Office is responsible for development and acquisition of capabilities to include robotics, unmanned ground sensors, installation security, mass notification, explosives detection, access control and surveillance systems. Located at Fort Belvoir, VA, the PM Force Protection Systems Office is aligned under the Program Executive Office for Combat Support and Combat Service Support, Warren, MI.